In the Claims

Please amend the claims as follows:

1. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, wherein the one or more pump wavelengths λ_p are less than at least a portion of the plurality of signal wavelengths λ_s, wherein the first length of Raman amplifier fiber is configured to introduce an effective optical noise figure to at least a portion of the plurality of signal wavelengths λ_s of less than 8 dB and less than an effective optical noise figure introduced by the second length of Raman amplifier fiber, and wherein the second length of Raman amplifier fiber is capable of introducing a gain level to at least some of the plurality of wavelengths λ_s of at least 5 dB;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction; and

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber.

2. (Original) The multi-stage optical amplifier of claim 1, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

3. (Original) The multi-stage optical amplifier of claim 1, wherein the pump shunt is coupled to the signal input port and the signal output port.

4. (Original) The multi-stage optical amplifier of claim 1, further comprising:

a distributed Raman amplifier coupled to the signal input port.

5. (Original) The multi-stage optical amplifier of claim 4, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

6. (Original) The multi-stage optical amplifier of claim 1, wherein the first and second lengths of Raman amplifier fiber each have a length greater than or equal to 200m.

7. (Original) The multi-stage optical amplifier of claim 1, wherein the one or more pump wavelengths λ_p are in the range of 1300 to 1530 nm.

8. (Original) The multi-stage optical amplifier of claim 1, wherein the plurality of signal wavelengths λ_s is in the range of 1430 to 1530 nm.

9. (Original) The multi-stage optical amplifier of claim 1, wherein the first lossy member is an optical isolator.

10. (Original) The multi-stage optical amplifier of claim 1, wherein the first lossy member is an add/drop multiplexer.

11. (Original) The multi-stage optical amplifier of claim 1, wherein the first lossy member is a gain equalization member.

12. (Original) The multi-stage optical amplifier of claim 1, wherein the first lossy member is a dispersion compensation element.

13. (Original) The multi-stage optical amplifier of claim 1, wherein at least a portion of at least one of the first and second Raman amplifier fibers is a dispersion compensating fiber.

14. (Original) The multi-stage optical amplifier of claim 13, wherein at least a portion of the first and second Raman amplifier fibers are dispersion compensating fibers.

15. (Original) The multi-stage optical amplifier of claim 1, wherein the second length of amplifier fiber has a higher gain than the first length of amplifier fiber.

16. (Original) The multi-stage optical amplifier of claim 3, further comprising:

at least one WDM coupler to couple a pump path from the signal input port to the signal output port.

17. (Original) The multi-stage optical amplifier of claim 1, further comprising:

a pump source coupled to the pump input port.

18. (Original) The multi-stage optical amplifier of claim 1, further comprising:

at least one laser diode pump source coupled to the pump input port.

19. (Original) The multi-stage optical amplifier of claim 1, further comprising:

a second lossy member coupled to the pump shunt.

20. (Original) The multi-stage optical amplifier of claim 1, wherein the pump shunt includes an optical fiber.

21. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, and wherein at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber comprises an optical fiber cut-off wavelength that is less than the one or more pump wavelengths λ_p;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers, the first length of Raman amplifier fiber being positioned between the signal input port and the pump input port and the second length of Raman amplifier fiber being positioned between the pump input port and signal output port;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction; and

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber.

22. (Original) The multi-stage optical amplifier of claim 21, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

23. (Original) The multi-stage optical amplifier of claim 21, wherein the pump shunt is coupled to the signal input port and the signal output port.

24. (Original) The multi-stage optical amplifier of claim 21, wherein optical fiber cut-off wavelengths of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber are less than the one or more pump wavelengths λ_p.

25. (Cancelled)

26. (Cancelled)

27. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the first and second lengths of Raman amplifier fiber each have a length greater than or equal to 200m.

28. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the one or more pump wavelengths λ_p are in the range of 1300 to 1530 nm.

29. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the plurality of signal wavelengths λ_s is in the range of 1430 to 1530 run.

30. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the first lossy member is an optical isolator.

31. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the first lossy member is an add/drop multiplexer.

32. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the first lossy member is a gain equalization member.

33. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the first lossy member is a dispersion compensation element.

34. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein at least a portion of at least one of the first and second Raman amplifier fibers is a dispersion compensating fiber.

35. (Original) The multi-stage optical amplifier of claim 34, wherein at least a portion of the first and second Raman amplifier fibers are dispersion compensating fibers.

36. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the second length of amplifier fiber has a higher gain than the first length of amplifier fiber.

37. (Previously Presented) The multi-stage optical amplifier of claim 21, further comprising:

at least one WDM coupler to couple a pump path from the signal input port to the signal output port.

38. (Previously Presented) The multi-stage optical amplifier of claim 21, further comprising:

a pump source coupled to the pump input port.

39. (Previously Presented) The multi-stage optical amplifier of claim 21, further comprising:

at least one laser diode pump source coupled to the pump input port.

40. (Previously Presented) The multi-stage optical amplifier of claim 21, further comprising:

a second lossy member coupled to the pump shunt.

41. (Previously Presented) The multi-stage optical amplifier of claim 21, wherein the pump shunt includes an optical fiber.

42. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber comprises a dispersion compensating fiber;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, wherein at least some of the plurality of signal wavelengths λ_s traverse the pump input port;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction; and

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber.

43. (Cancelled)

44. (Original) The multi-stage optical amplifier of claim 42, wherein an optical fiber cut-off wavelength of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is less than the one or more pump wavelengths λ_p.

45. (Original) The multi-stage optical amplifier of claim 42, wherein at least a portion of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber are dispersion compensating fibers.

46. (Original) The multi-stage optical amplifier of claim 42, wherein the dispersion compensating fiber has a magnitude of dispersion of at least 50 psec/(nm) (km) for at least a portion of the plurality of signal wavelengths λ_s.

47. (Original) The multi-stage optical amplifier of claim 42, wherein the dispersion compensating fiber has a magnitude of dispersion less than 50 psec/(nm) (km) for at least a portion of the plurality of signal wavelengths λ_s.

48. (Cancelled)

49. (Cancelled)

50. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s,

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber;

a distributed Raman amplifier coupled to the signal input port or the signal output port; and

at least a first pump source coupled to pump input port, the at least first pump source including multiple pump sources with outputs that are combined using at least one of wavelength and polarization multiplexing.

51. (Original) The multi-stage optical amplifier of claim 50, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

52. (Original) The multi-stage optical amplifier of claim 50, wherein the pump shunt is coupled to the signal input port and the signal output port.

53. (Original) The multi-stage optical amplifier of claim 50, wherein the at least first pump source includes multiple pump sources with outputs that are combined using wavelength and polarization multiplexing.

54. (Cancelled)

55. (Previously Presented) The multi-stage optical amplifier of Claim 50, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

56. (Previously Presented) A multi-stage optical amplifier system, comprising:

a plurality of transmitters that produce a plurality of signal wavelengths λ_s;

a multi-stage optical amplifier comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers coupled to the plurality of transmitters and configured to be coupled to one or more pump sources that produce one or more pump wavelengths λ_p, wherein the one or more pump wavelengths λ_p are less than at least a portion of the plurality of signal wavelengths λ_s, wherein the first length of Raman amplifier fiber is configured to introduce an effective optical noise figure to at least a portion of the plurality of signal wavelengths λ_s of less than 8 dB and less than an effective optical noise figure introduced by the second length of Raman amplifier fiber, and wherein the second length of Raman amplifier fiber is capable of introducing a gain level to at least some of the plurality of wavelengths λ_s of at least 5 dB;

a signal input port coupled to the one or more optical fibers,

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction,

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber; and

a plurality of receivers coupled to the multi-stage optical amplifier.

57. (Original) The multi-stage optical amplifier system of claim 56, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

58. (Original) The multi-stage optical amplifier system of claim 56, wherein the pump shunt is coupled to the signal input port and the signal output port.

59. (Original) The multi-stage optical amplifier system of claim 56, further comprising:

a distributed Raman amplifier coupled to the signal input port.

60. (Original) The multi-stage optical amplifier system of claim 59, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

61. (Original) The multi-stage optical amplifier system of claim 56, wherein the multi-stage optical amplifier is an in-line amplifier.

62. (Original) The multi-stage optical amplifier system of claim 56, wherein the multi-stage optical amplifier is a booster amplifier.

63. (Original) The multi-stage optical amplifier system of claim 56, wherein the multi-stage optical amplifier is a pre-amplifier.

64. (Original) The multi-stage optical amplifier system of claim 56, wherein the plurality of receivers are directly coupled to the multi-stage optical amplifier.

65. (Previously Presented) A multi-stage optical amplifier system, comprising:

a plurality of transmitters that produce a plurality of signal wavelengths λ_s;

a multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers coupled to the plurality of transmitters and configured to be coupled to one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, and wherein at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber comprises an optical fiber cut-off wavelength that is less than the one or more pump wavelengths λ_p,

a signal input port coupled to the one or more optical fibers,

a signal output port coupled to the one or more optical fibers,

a pump input port coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, wherein at least some of the plurality of signal wavelengths λ_s traverse the pump input port;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction,

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber; and

a plurality of receivers coupled to the multi-stage optical amplifier.

66. (Cancelled)

67. (Original) The multi-stage optical amplifier system of claim 65, wherein the pump shunt is coupled to the signal input port and the signal output port.

68. (Original) The multi-stage optical amplifier system of claim 65, wherein optical fiber cut-off wavelengths of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber are less than the one or more pump wavelengths λ_p.

69. (Previously Presented) The multi-stage optical amplifier system of claim 65, further comprising:

a distributed Raman amplifier coupled to the signal input port or the signal output port.

70. (Original) The multi-stage optical amplifier system of claim 69, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

71. (Original) The multi-stage optical amplifier system of claim 69, wherein the multi-stage optical amplifier is an in-line amplifier.

72. (Original) The multi-stage optical amplifier system of claim 69, wherein the multi-stage optical amplifier is a booster amplifier.

73. (Original) The multi-stage optical amplifier system of claim 69, wherein the multi-stage optical amplifier is a pre-amplifier.

74. (Original) The multi-stage optical amplifier system of claim 69, wherein the plurality of receivers are directly coupled to the multi-stage optical amplifier.

75. (Previously Presented) A multi-stage optical amplifier system, comprising:

a plurality of transmitters that produce a plurality of signal wavelengths λ_s;

a multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers coupled to the plurality of transmitters and configured to be coupled to one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is a dispersion compensating fiber;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers, the first length of Raman amplifier fiber being positioned between the signal input port and the pump input port and the second length of Raman amplifier fiber being positioned between the pump input port and signal output port;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber; and

a plurality of receivers coupled to the multi-stage optical amplifier.

76. (Cancelled)

77. (Previously Presented) The multi-stage optical amplifier system of claim 75, wherein an optical fiber cut-off wavelength of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is less than the one or more pump wavelengths λ_p.

78. (Original) The multi-stage optical amplifier system of claim 75, wherein at least a portion of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber are dispersion compensating fibers.

79. (Previously Presented) The multi-stage optical amplifier system of claim 75, wherein the dispersion compensating fiber has a magnitude of dispersion greater than 50 psec/(nm) (km) for at least a portion of the plurality of signal wavelengths λ_s.

80. (Previously Presented) The multi-stage optical amplifier system of claim 75, wherein the dispersion compensating fiber has a magnitude of dispersion less than 50 psec/(nm) (km) for at least a portion of the plurality of signal wavelengths λ_s.

81. (Previously Presented) The multi-stage optical amplifier system of claim 75, further comprising:

a distributed Raman amplifier coupled to the signal input port or the signal output port.

82. (Original) The multi-stage optical amplifier system of claim 81, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

83. (Original) The multi-stage optical amplifier system of claim 75, wherein the multi-stage optical amplifier is an in-line amplifier.

84. (Original) The multi-stage optical amplifier system of claim 75, wherein the multi-stage optical amplifier is a booster amplifier.

85. (Original) The multi-stage optical amplifier system of claim 75, wherein the multi-stage optical amplifier is a pre-amplifier.

86. (Original) The multi-stage optical amplifier system of claim 75, wherein the plurality of receivers are directly coupled to the multi-stage optical amplifier.

87. (Previously Presented) A multi-stage optical amplifier system, comprising:

a plurality of transmitters that produce a plurality of signal wavelengths λ_s;

a multi-stage optical amplifier comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers coupled to the plurality of transmitters and configured to be coupled to one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s,

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction,

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber,

at least a first pump source coupled to pump input port, the at least first pump source including multiple pump sources with outputs that are combined using at least one of wavelength and polarization multiplexing;

a plurality of receivers coupled to the multi-stage optical amplifier; and

a distributed Raman amplifier coupled to the signal input port or the signal output port.

88. (Original) The multi-stage optical amplifier system of claim 87, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

89. (Original) The multi-stage optical amplifier system of claim 87, wherein the pump shunt is coupled to the signal input port and the signal output port.

90. (Original) The multi-stage optical amplifier system of claim 87, wherein at least first pump source includes multiple pump sources with outputs that are combined using wavelength and polarization multiplexing.

91. (Cancelled)

92. (Previously Presented) The multi-stage optical amplifier system of claim 87, wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

93. (Original) The multi-stage optical amplifier system of claim 87, wherein the multi-stage optical amplifier is an in-line amplifier.

94. (Original) The multi-stage optical amplifier system of claim 87, wherein the multi-stage optical amplifier is a booster amplifier.

95. (Original) The multi-stage optical amplifier system of claim 87, wherein the multi-stage optical amplifier is a pre-amplifier.

96. (Original) The multi-stage optical amplifier system of claim 87, wherein the plurality of receivers are directly coupled to the multi-stage optical amplifier.

97. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources that produce a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is a fiber with a selected small effective core area and high germanium doping to provide an enhancement of a Raman gain coefficient;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber; and

a distributed Raman amplifier coupled to the signal input port or the signal output port.

98. (Original) The multi-stage optical amplifier of claim 97, wherein the pump input port is positioned between the first and second lengths of Raman amplifier fiber.

99. (Original) The multi-stage optical amplifier of claim 97, wherein an optical fiber cut-off wavelength of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is less than the one or more pump wavelengths λ_p.

100. (Original) The multi-stage optical amplifier of claim 97, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is a dispersion compensating fiber.

101. (Original) The multi-stage optical amplifier of claim 97, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is a dispersion compensating fiber.

102. (Previously Presented) A multi-stage optical amplifier system, comprising:

a plurality of transmitters that produce a plurality of signal wavelengths λ_s;

a multi-stage optical amplifier comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers coupled to the plurality of transmitters and configured to be coupled to one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber is a fiber with a selected small effective core area and high germanium doping to provide an enhancement of a Raman gain coefficient,

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber;

a plurality of receivers coupled to the multi-stage optical amplifier; and

a distributed Raman amplifier coupled to the signal input port or the signal output port.

103. (Currently Amended) A multi-stage optical amplifier, comprising:

one or more optical ~~fibers fibers;~~ fibers, a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, and wherein at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber comprises an optical fiber cut-off wavelength that is less than the one or more pump wavelengths λ_p;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a distributed Raman amplifier coupled to the signal input port or the signal output port; and

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber.

104. (Currently Amended) The multi-stage optical amplifier of Claim 103, ~~claim 25,~~ wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.

105. (Previously Presented) A multi-stage optical amplifier, comprising:

one or more optical fibers comprising a first length of Raman amplifier fiber and a second length of Raman amplifier fiber, the one or more optical fibers configured to be coupled to one or more signal sources producing a plurality of signal wavelengths λ_s and one or more pump sources that produce one or more pump wavelengths λ_p, the one or more pump wavelengths λ_p being less than at least a portion of the plurality of signal wavelengths λ_s, wherein at least a portion of at least one of the first length of Raman amplifier fiber and the second length of Raman amplifier fiber comprises a dispersion compensating fiber;

a signal input port coupled to the one or more optical fibers;

a signal output port coupled to the one or more optical fibers;

a pump input port coupled to the one or more optical fibers;

a first lossy member coupled to the one or more optical fibers and positioned between the first and second lengths of Raman amplifier fiber, the first lossy member being lossy in at least one direction;

a distributed Raman amplifier coupled to the signal input port or the signal output port; and

a pump shunt coupled to the one or more optical fibers, wherein at least a portion of the one or more pump wavelengths λ_p is coupled between the first length of Raman amplifier fiber and the second length of Raman amplifier fiber.

106. (Currently Amended) The multi-stage optical amplifier of Claim 105, ~~claim 48,~~ wherein at least a portion of the pump shunt is positioned between the distributed Raman amplifier and the signal input port.